

5402. (amended) The method of claim 2232, wherein a pyrolysis zone is established in the part of the formation.

5404. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from heaters disposed in the formation to a portion of the formation to produce heated zones adjacent to the heaters, wherein at least one of the heaters comprises a natural distributed combustor;
allowing the heat to transfer from the heated zones to form a pyrolysis zone, wherein an average temperature in the pyrolysis zone is at a temperature sufficient to pyrolyze hydrocarbons;
and
allowing the heat to transfer to the pyrolysis zone from the heated zones at rates sufficient to increase a permeability of the pyrolysis zone such that the permeability in the pyrolysis zone is substantially uniform.

5407. (amended) The method of claim 5404, wherein at least one of the heaters is disposed in an open wellbore.

Response To Final Office Action Mailed December 24, 2002

A. Pending Claims

Claims 2193-2200, 2202-2239, 2241-2269, 5396-5405, and 5407-5410 are currently pending. Claims 2193-2195, 2202, 2204, 2216, 2227, 2232-2234, 2241, 2243, 2255, 2264, 2265, 5399, 5402, 5404, and 5407 have been amended. Claims 2194, 2195, 2202, 2204, 2216, 2227, 2233, 2234, 2241, 2243, 2255, 2264, 2265, and 5407 have been amended for clarification and/or for correction of typographical errors. Support for the amendment to claims 2195 and 2234 is found at least in the Specification on page 46, lines 14-15. Claims 2201, 2240, and 5406 have been cancelled.

B. Submission of Corrected Formal Drawings

In the Office Action mailed December 24, 2002, the Examiner indicated approval of the proposed drawing corrections filed on March 13, 2002. Applicant submits the corrected formal drawings approved by the Examiner (nine sheets, including FIGS. 23a, 23b, 32, 56, 57, 67, 68, 72, 73, 76, 81a, and 97).

C. The Claims Are Not Unsupported Pursuant To 35 U.S.C. § 112, First Paragraph

Claims 5404-5410 were rejected under 35 U.S.C. § 112, first paragraph, as “containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.” Applicant has removed the reference to an “interconnected” pyrolysis zone from independent claim 5404. Applicant respectfully requests removal of the rejections of claim 5404 and the claims dependent thereon.

D. The Claims Are Not Indefinite Pursuant To 35 U.S.C. § 112, Second Paragraph

Claims 2193-2196, 2198-2235, 2238-2269, and 5396-5403 were rejected under 35 U.S.C. § 112, second paragraph, as “being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.” Applicant has amended claims 2193, 2232, 5398, and 5402 as suggested by the Examiner. Applicant respectfully requests removal of the rejections of the claims.

E. Double Patenting Rejection

The Examiner provisionally rejected claims 2193-2269 and 5396-5410 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over copending U.S. Patent Application No. 09/841,284. Upon issuance of a patent for U.S. Patent

Application No. 09/841,284 or the present application, or upon both applications being in condition for allowance but for the provisional double patenting rejection, Applicant will provide arguments for the inappropriateness of the double patenting rejection and/or provide a terminal disclaimer for the patent and/or patent applications.

F. The Claims Are Not Anticipated By Or Obvious Over Ljungstrom Pursuant To 35 U.S.C. § 102(b) or 103(a) Respectively

The Examiner rejected claims 2193-2196, 2200, 2203, 2205-2215, 2217, 2218, 2226, 2227, 2232-2235, 2238, 2239, 2242, 2244-2254, 2256, 2257, 2265, 5398-5405, 5407, 5408, and 5409 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 2,923,535 to Ljungstrom et al. (hereinafter "Ljungstrom"). Applicant respectfully disagrees with the rejections.

The Examiner states: "It is noted that claims 2199, 2201, 2240, and 5406 have been rejected only on the grounds of double patenting and/or 35 USC 112(2). Applicant submits that the 35 USC 112(2) rejections of claims have been addressed in Sections C and D.

Claims 2193 and 2232 have been amended to include the features of claims 2201 and 2240, respectively. Amended claims 2193 and 2232 describe a combination of features including: "providing heat from one or more heaters disposed in the formation to at least a portion of the formation such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range". Applicant respectfully requests removal of the rejections of claims 2193 and 2232.

Claim 5404 has been amended to include the features of claim 5406. Amended claim 5404 describes a combination of features including: "providing heat from heaters disposed in the formation to a portion of the formation to produce heated zones adjacent to the heaters, wherein at least one of the heaters comprises a natural distributed combustor". Applicant respectfully requests removal of the rejection of claim 5404.

If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

Applicants respectfully requests removal of the rejections of claims dependent on claims 2193, 2232, and 5404. Applicant submits, in addition, that many of the claims dependent on claims 2193, 2232, and 5404 are separately patentable.

The standard for “anticipation” is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed. Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed. Cir. 1985).

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 U.S.P.Q. 173, 177-178 (C.C.P.A. 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

The Examiner states: “to increase the permeability to greater than 100 millidarcy or 5 Darcy would have been an obvious matter of choice in order to ensure adequate fluid flow through the formation.” The Examiner further states: “formations of less than 100 millidarcy are normally characterized or deemed in the art as being of ‘low permeability’.... Since, however, Ljungstrom, as noted above, discloses that the formation is rendered sufficiently permeable by the electrical heating phase to then allow the subsequent in situ combustion phase to be successfully carried out, it must, i.e., inherently, possess a permeability ‘greater than 100 millidarcy’, as defined by the state of the art observation of Ware et al.”

Claim 2226 describes a combination of features including: “increasing a permeability of a majority of the part of the formation to greater than about 5 Darcy.” Ljungstrom does not appear to teach or suggest a value of a permeability of a part of a formation. Applicant submits

that the heating methods taught and suggested by Ware and/or Ljungstrom would not appear to teach or suggest treating a formation to increase a permeability of the formation to greater than about 5 Darcy. Applicant respectfully requests removal of the rejection of claim 2226.

G. The Claims Are Not Obvious Over Ljungstrom Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2202, 2204, 2219, 2222, 2228, 2229, 2241, 2243, 2258, 2261, 2266, 2267, 5396, 5397, and 5410 under 35 U.S.C. 103(a) as being unpatentable over Ljungstrom. Applicant respectfully disagrees with the rejections.

At least for the reasons described in Section E, Applicant submits that claims 2193, 2232, and 5404 are in condition for allowance. Dependent claims 2202, 2204, 2219, 2222, 2228, 2229, 2241, 2243, 2258, 2261, 2266, 2267, 5396, 5397, and 5410 are therefore nonobvious. Applicant therefore requests removal of the rejections of claims 2202, 2204, 2219, 2222, 2228, 2229, 2241, 2243, 2258, 2261, 2266, 2267, 5396, and 5397. Applicant submits, in addition, that many of the above-listed claims are separately patentable.

The Examiner states: "With respect to claims 2202, 2241 and 5410, Ljungstrom discloses controlling or maintaining the temperature within a specific operating range (col. 2, lines 25-48); it would have been an obvious expedient to effect such temperature control, at least in part by controlling the heating rate to the level recited. The formula depicted in these claims appears to comprise a common power relationship based on major formation characteristics with no criticality or unexpected results observed for the recited average heating rate of 10oC/day."

Applicant's Specification discloses: "In an alternative embodiment, at least a portion of the formation may be heated to a temperature such that at least a portion of the hydrocarbon containing formation may be converted to coke and/or char. Coke and/or char may be formed at temperatures above about 400 °C and at a high heating rate (e.g., above about 10 °C/day)." (Specification, page 82, lines 11-14) The recited heating rate does appear to have criticality and/or unexpected results not taught or suggested by the cited art.

Claims 2202, 2241, and 5410 describe a combination of features including: “wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.” Applicant submits that Ljungstrom does not appear to teach or suggest using a desired heating rate to calculate a maximum average heating energy/day to be applied to a selected volume of a formation. Applicant respectfully requests removal of the rejections of claims 2202, 2241, and 5410.

H. The Claims Are Not Obvious Over Ljungstrom In View of Tsai Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2216, 2220, 2221, 2255, 2259, and 2260 under 35 U.S.C. 103(a) as being unpatentable over Ljungstrom as applied to claim 2193 above, and further in view of U.S. Patent No. 4,299,285 to Tsai et al. (hereinafter “Tsai”). Applicant respectfully disagrees with the rejections.

The Examiner states:

While Ljungstrom does not disclose the presence of hydrogen in a coal or oil shale heating production effluent, Tsia et al. (col. 5, line 52 – col. 6, line 15) clearly discloses that gasification/volatilization products resulting from heating and/or gasifying a coal formation include hydrogen.

Accordingly, it is deemed that the volatilized/gasified coal production effluent produced in the process of Ljungstrom will obviously include a hydrogen component, as taught by Tsai et al, with the precise amount of hydrogen present, as called for in claims 2216, 2220, 2255, 2259....

Tsai states: “The net result is a combustible product gas comprising carbon monoxide, hydrogen and some methane as its principal combustibles....” (Tsai, col. 5, lines 55-58) Applicant submits that the Examiner’s statement “that the...effluent produced in the process of Ljungstrom will obviously include a hydrogen component...with the precise amount of hydrogen

present as called for in claims 2216, 2220, 2255, 2259, and 2260....” is extending the teaching of Tsai.

Amended claims 2216 and 2255 describe a combination of features including: “producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component at 25 °C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.” Applicant submits that the combination of the cited art does not appear to teach or suggest the range of molecular hydrogen content by volume percent recited in claims 2216 and 2255. Applicant respectfully requests removal of the rejections of claims 2216 and 2255.

Claims 2220 and 2259 describe a combination of features including: “controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H₂ within the mixture is greater than about 0.5 bar.” Applicant submits that the combination of the cited art does not appear to teach or suggest controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H₂ within the mixture is greater than about 0.5 bar. Applicant respectfully requests removal of the rejections of claims 2220 and 2259.

I. The Claims Are Not Obvious Over Ljungstrom In View of Justheim Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2216, 2220, 2221, 2223, 2224, 2256, 2259, 2260, 2262, and 2263 under 35 U.S.C. 103(a) as obvious over Ljungstrom, as applied to claim 2193, and further in view of U.S. Patent No. 3,766,982 to Justheim (hereinafter “Justheim ‘982”). Applicant respectfully disagrees with the rejections.

The Examiner states:

As per claims 2216, 2220, 2256 and 2259, in carrying out the injection of hydrogen into the coal formation to effect hydrogenation of the volatilized/pyrolyzed hydrocarbons evolved, in the modified process of Ljungstrom, the production fluids actually produced will necessarily or obviously include a partial pressure of hydrogen, with the precise amount thereof deemed an obvious matter of choice or design, based on, e.g., the particular coal or oil shale formation encountered.

Amended claims 2216 and 2255 describe a combination of features including:

“producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component at 25 °C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.”

Claims 2220 and 2259 describes a combination of features including: “controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H₂ within the mixture is greater than about 0.5 bar.”

Applicant submits that the Examiner is extending the teaching of Justheim in the rejections of claims 2216, 2220, 2255, and 2259 to include a specific content of a component in a produced mixture (e.g., a partial pressure of H₂ within the mixture greater than about 0.5 bar; greater than about 10 % by volume and less than about 80% by volume of the non-condensable component). Applicant submits that the combination of the cited art does not appear to teach or suggest achieving a specific content of hydrogen in a produced mixture. Applicant respectfully requests removal of the rejections of claims 2216, 2220, 2255, and 2259.

J. The Claims Are Not Anticipated By Or Obvious Over Pelofsky Pursuant To 35 U.S.C. § 102(b) or 103(a) Respectively

The Examiner rejected claims 2193-2195, 2200, 2202, 2203, 2219, 2226, 2227, 2230-2234, 2239, 2241, 2242, 2258, 2265, 2268, 2269, 5398, 5399, 5401, 5402, 5404, 5405, 5409, and

5410 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 3,882,941 to Pelofsky (hereinafter "Pelofsky"). Applicant respectfully disagrees with the rejections.

The Examiner states:

Applicant's arguments against Pelofsky (3,882,941) are not deemed persuasive. Contrary to applicant's arguments regarding claims 2193, 2232 and 5404, the claims, as amended, do not require the heaters to be in the formation or wellbore(s). Accordingly, it is deemed that a 'heater' would be inherently or obviously be utilized by the process of Pelofsky in order to provide the hot fluids for injection. This rejection, as well as other rejections based on Pelofsky, could be overcome if the independent claims 2193 and 2232 (and 5404?) were amended to indicate that the 'one or more heaters' are – disposed in the formation – (and clearly indicating only a single 'one or more heaters' included, as noted above).

Applicant has amended claims 2193, 2232, and 5404 as suggested by the Examiner to include the feature of "heaters disposed in the formation". Applicant respectfully requests removal of the rejection of claims 2193, 2232, 5404, and claims dependent thereon.

K. The Claims Are Not Anticipated By Or Obvious Over Sresty Pursuant To 35 U.S.C. § 102(b) or 103(a) Respectively

The Examiner rejected claims 2193-2196, 2200, 2202, 2205-2218, 2226-2228, 2232-2235, 2239, 2241, 2244-2257, 2265, 2266, 5398-5405, and 5407-5410 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,485,869 to Sresty (hereinafter "Sresty"). Applicant respectfully disagrees with the rejections.

For at least the reasons described in the sections above, Applicant submits that claims 2193, 2232, 5404, and the claims dependent thereon are in condition for allowance. Applicant respectfully requests removal of rejections of claims 2193-2196, 2200, 2202, 2205-2218, 2226-2228, 2232-2235, 2239, 2241, 2244-2257, 2265, 2266, 5398-5405, and 5407-5410.

L. Conclusion

Applicant submits that all claims are in condition for allowance. Applicant submits that the amendments do not require any further search on the part of the Examiner. Favorable consideration is respectfully requested.

Applicant believes that no fees are due with the filing of this document. If any extension of time is required, Applicant hereby requests the appropriate extension of time. If any fees are required, please appropriately charge those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5659-02400/EBM.

Respectfully submitted,



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Marked-Up Version of Amendments Submitted With
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In the Claims:

2193. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from one or more heaters disposed in the formation to at least a portion of
the formation such that an average heating rate of the part of the formation is less than about 1 °C
per day in a pyrolysis temperature range; and

allowing the heat to transfer from the one or more heaters to a part of the formation such
that a permeability of at least a portion of the part of the formation increases to greater than about
100 millidarcy.

2194. (amended) The method of claim 2193, wherein the one or more heaters comprise at least
two heaters, and wherein controlled superposition of heat from at least the two heaters pyrolyzes
at least some hydrocarbons within the part of the formation.

2195. (amended) The method of claim 2193, further comprising maintaining a temperature
within the part of the formation within a pyrolysis temperature range of about 270 °C to about
400 °C.

2202. (amended) The method of claim 2193, wherein providing heat from one or more of the
heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from one or more
of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating
pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than
 $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the
selected volume is about 10 °C/day.

2204. (amended) The method of claim 2193, wherein providing heat from one or more of the heaters ~~comprises heating the part of the formation such that~~increases a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

2216. (amended) The method of claim 2193, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component at 25 °C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

2227. (amended) The method of claim 2193, wherein allowing the heat to transfer ~~comprises~~ substantially uniformly increasingincreases a permeability of a majority of the part of the formation such that the permeability of the majority of the part of the formation is substantially uniform.

2232. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from one or more heaters disposed in the formation to at least a portion of the formation such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range; and

allowing the heat to transfer from the one or more heaters to a part of the formation such that a permeability of a majority of at least a portion of the part of the formation increases and such permeability is substantially uniform.

2233. (amended) The method of claim 2232, wherein the one or more heaters comprise at least two heaters, and wherein controlled superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

2234. (amended) The method of claim 2232, further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

2241. (amended) The method of claim 2232, wherein providing heat from one or more of the heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

2243. (amended) The method of claim 2232, wherein providing heat from one or more of the heaters ~~comprises heating the part of the formation such that~~increases a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

2255. (amended) The method of claim 2232, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component at 25 °C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

2264. (amended) The method of claim 2232, further comprising:

producing hydrogen (H₂) and condensable hydrocarbons from the formation; and

hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

2265. (amended) The method of claim 2232, wherein allowing the heat to transfer ~~comprises increasing~~increases a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

5399. (amended) The method of claim 2193, wherein ~~the part of the formation comprises a~~ pyrolysis zone is established in the part of the formation.

5402. (amended) The method of claim 2232, wherein ~~the part of the formation comprises a~~ pyrolysis zone is established in the part of the formation.

5404. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:
providing heat from heaters disposed in the formation to a portion of the formation to
produce heated zones adjacent to the heaters, wherein at least one of the heaters comprises a
natural distributed combustor;

allowing the heat to transfer from the heated zones to form ~~an interconnected~~ a pyrolysis
zone, wherein an average temperature in the pyrolysis zone is at a temperature sufficient to
pyrolyze hydrocarbons; and

allowing the heat to transfer to the pyrolysis zone from the heated zones at rates sufficient
to increase a permeability of the pyrolysis zone such that the permeability in the pyrolysis zone is
substantially uniform.

5407. (amended) The method of claim 5404, wherein at least one of the heaters ~~heater~~ is
disposed in an open wellbore.